इंटरनेट मानक

Disclosure to Promote the Right To Information

Whereas the Parliament of India has set out to provide a practical regime of right to information for citizens to secure access to information under the control of public authorities, in order to promote transparency and accountability in the working of every public authority, and whereas the attached publication of the Bureau of Indian Standards is of particular interest to the public, particularly disadvantaged communities and those engaged in the pursuit of education and knowledge, the attached public safety standard is made available to promote the timely dissemination of this information in an accurate manner to the public.

“जानने का अधिकार, जीने का अधिकार”
Mazdoor Kisan Shakti Sangathan
“The Right to Information, The Right to Live”

“पुराने को छोड नये के तरफ”
Jawaharlal Nehru
“Step Out From the Old to the New”

IS 13316 (1992): Welded Austenitic Stainless Steel Tubes for Heat Exchangers for the Sugar Industry [FAD 2: Sugar Industry]

“ज्ञान से एक नये भारत का निर्माण”
Satyanarayan Gangaram Pitroda
“Invent a New India Using Knowledge”

Act Number 22 of 2005
The Indian Parliament
RIGHT TO INFORMATION

Made Available By
Public.Resource.Org

“ज्ञान एक ऐसा खजाना है जो कभी चुराया नहीं जा सकता है”
Bhartṛhari—Nītiśatakam
“Knowledge is such a treasure which cannot be stolen”

BLANK PAGE

BRUTUM FULMEN

IGNORANTIA
JURIS
NON EXCUSAT

PROTECTED BY COPYRIGHT

IS 13316 : 1992
(Reaffirmed 2002)

भारतीय मानक

शर्करा उद्योग में ऊष्मा विनिमय यंत्रों के लिए आस्टेनाइटी वेल्डित नलिकाओं – विशिष्टि

Indian Standard

WELDED AUSTENITIC STAINLESS STEEL TUBES FOR HEAT EXCHANGERS FOR THE SUGAR INDUSTRY — SPECIFICATION

UDC 621·643·23 : 66·045 : 664·1

© BIS 1992

BUREAU OF INDIAN STANDARDS
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG
NEW DELHI 110002

January 1992 **Price Group 2**

Sugar Industry Sectional Committee, FAD 2

FOREWORD

This Indian Standard was adopted by the Bureau of Indian Standards, after the draft finalized by the Sugar Industry Sectional Committee had been approved by the Food and Agriculture Division Council.

This Indian Standard has been prepared to assist users and manufacturers of welded austenitic stainless steel tubes for heat exchangers in sugar industry. These heat exchanger tubes find use in juice heaters, evaporators and pans.

In the preparation of this standard, the manufacturing and trade practices being followed in the country have been kept in view. Assistance has also been derived from ASTM A 249/A 249M-87a 'Standard specification for welded austenitic steel boiler, superheater, heat exchanger and condenser tubes'.

Welded austenitic stainless steel heat exchanger tubes used in sugar industry are drift expanded in tube plates in order to prevent contamination of the heating medium by the sugar cane juice.

Besides, the austenitic stainless steel tubes and their weld seams are required to withstand drift expansion without development of cracks. To ensure compliance to these parameters, mechanical tests such as flattening test, drift expanding test, reverse bend test and tensile test have been stipulated in the Standard.

For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the result of a test or analysis, shall be rounded off in accordance with IS 2 : 1960 'Rules for rounding off numerical values (*revised*)'. The number of significant places retained in the rounded off value should be the same as that of the specified value in this Standard.

Indian Standard

WELDED AUSTENITIC STAINLESS STEEL TUBES FOR HEAT EXCHANGERS FOR THE SUGAR INDUSTRY — SPECIFICATION

1 SCOPE

This standard covers the requirements and methods for sampling and test for welded austenitic stainless steel tubes for the sugar industry covering juice heaters, evaporators and vacuum pans.

2 REFERENCES

The following Indian Standards are necessary adjuncts to this standard.

IS No.	*Title*
1387 : 1967	General requirements for the supply of metallurgical materials (*first revision*)
1500 : 1983	Method for Brinell hardness test for metallic materials (*second revision*)
1894 : 1972	Method for tensile testing of steel tubes (*first revision*)
2328 : 1986	Method of flattening test on steel tubes (*first revision*)
2335 : 1985	Method of drift expanding test on metallic tubes (*first revision*)
4711 : 1974	Methods for sampling of steel pipes, tubes and fittings (*first revision*)
6398 : 1983	Code of practice for eddy current testing of seamless non-ferrous pipes and tubes (*first revision*)
6911 : 1972	Stainless steel plate, sheet and strip.
10461 (Part 1) : 1983	Method for determination of resistance to intergranular corrosion of austenitic stainless steels : Part 1 Corrosion test in nitric acid medium by measurement of loss in mass (Huey test)
10461 (Part 2) : 1983	Method for determination of resistance to intergranular corrosion of austenitic stainless steels : Part 2 Corrosion test in sulphuric acid/copper sulphate medium in the presence of copper turnings (Monypenny Straus Test)

3 SUPPLY OF MATERIAL

General requirements relating to the supply of material shall be as laid down in IS 1387 : 1967.

4 MANUFACTURE

4.1 The steel shall be made by the electric-furnace process or by other similar primary processes approved by the purchaser.

4.2 The tubes shall be made from flat-rolled steel by shielded arc inert gas welding process without any addition of filler metal.

4.3 Subsequent to welding and prior to final heat treatment, the tubes shall be cold worked either in both weld and base metal or in weld metal only. When cold worked in weld, the inner surface should be free from bead. If bead is existing, it should not be more than 5 percent of wall thickness.

4.3.1 However, it is preferable to have the inner surface free from bead, since any bead inside may lead to problems when the tubes are cleaned by brushes.

5 CHEMICAL COMPOSITION

5.1 The steel shall conform to the requirements of one of the following two grades of steel specified in IS 6911 : 1972. The chemical composition (ladle analysis) of these two grades shall be as specified in Table 1.

5.2 In case of product analysis for the chemical composition, the permissible variations from the above ladle analysis shall be in accordance to the requirements of IS 6911 : 1972.

Table 1 Chemical Composition

(*Clause* 5.1)

Steel Designation	Constituent, Percent							
	C *Max*	Si *Max*	Mn *Max*	S *Max*	P *Max*	Ni	Cr	Mo
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
04 Cr 18 Ni 10	0·08	1·0	2·0	0·03	0·045	8-12	17-20	—
02 Cr 18 Ni 11	0·03	1·0	2·0	0·03	0·045	9-13	17-20	—

5.3 The seller shall provide material test certificates (chemical composition) of the steel strips used in the manufacture of the tubes. The buyer of tubes may, however, ask for chemical analysis of samples of steel from the finished tubes. Sampling procedure as given in **11.1** shall be followed for the purpose.

6 HEAT TREATMENT

6.1 All tubes shall be supplied in annealed condition done only by continuous electric furnace with automatic temperature controller.

6.2 The annealing shall consist of heating the tubes to a temperature range of 1 040-1 120°C and cooling rapidly by water, oil or air.

6.3 The finished annealed tubes shall stand expanding and beading without showing cracks or flaws.

7 MECHANICAL PROPERTIES

7.0 The tubes shall satisfy the requirements of the mechanical tests given below. Sampling shall be according to **11.2**.

7.1 Tensile Test

7.1.1 The tensile test shall be made on lengths cut from the ends of selected tubes (the ends being plugged for grips where necessary) or on longitudinal strips, not including the weld, cut from tubes. The tensile strength, yield stress and the percentage elongation shall be determined in accordance with IS 1894 : 1972 and shall be not less than the value specified in Table 2.

7.1.2 The elongation percent given in Table 2 is applicable when a full section of the tube is tested. If strip tests are made, then the width of the gauge length (GL) shall be 38·1 mm and the minimum elongation percent required in a 50 mm guage length shall be computed from the following formula:

$$E = 2{\cdot}2\,t + 17{\cdot}5$$

where

E = Elongation, percent (on 50 mm guage length); and

t = Actual thickness of specimen in mm.

7.2 Flattening Test

7.2.1 A section of tube not less than 100 mm in length shall be flattened cold between parallel plates in accordance with IS 2328 : 1986 until the distance between parallel plates H is less than the value of H calculated by the following formula:

$$H = \frac{(1 + e)\,t}{e + t/D}$$

where

H = distance between flattening plates, mm;

t = specified wall thickness of tube, mm;

D = specified outside diameter of tubes, mm; and

e = deformation per unit length, which is 0·09 for austenitic steel.

7.2.2 Evidence of laminated or unsound material or incomplete weld that is revealed during the test shall be cause for rejection of the lot.

Table 2 Mechanical Properties of Steel Tubes

(*Clauses* 7.1.1 *and* 7.1.2)

Steel Desigation	Tensile Strength *Min* N/mm^2	Yield Stress, *Min* N/mm^2	Percent Elongation in 50 mm GL, *Min*
04Cr 18Ni10	490	200	38
02Cr 18Ni11	440	180	38

7.3 Drift Expanding Test

When tested in accordance with the test requirements specified in IS 2335 : 1985 after expansion by a conical mandrel having an included angle of 60°, the increase of the end of the tube shall be a minimum of 25 percent, without showing any sign of a crack.

7.4 Reverse Bend Test

7.4.1 A section of tube 100 mm in length shall be split longitudinally 90° on each side of the weld. The sample shall then be opened and bent around a mandrel with a diameter four times the wall thickness, with mandrel parallel to the weld and on the outside of the tube. The weld shall be at the point of maximum bend.

7.4.2 The test piece shall be deemed to have passed the test, if there is no evidence of cracks or lack of penetration or overlaps in the weld.

7.5 Hydrostatic Test

7.5.1 Each tube shall be subjected to internal hydrostatic test pressure of 6·86 MPa. Test pressure shall be held for a minimum of 5 seconds. The tube that shows any sign of leakage or sweating during this test shall be rejected.

7.6 Eddy Current Test

7.6.1 Each tube shall be subjected to eddy current test in accordnce with the procedure laid down in IS 6398 : 1983, when specified by the purchaser.

7.7 Hardness Test

7.7.1 One finished tube from every lot shall be subjected to Brinell hardness test in accordance with the procedure laid down in IS 1500 : 1983. The hardness shall not be less than 192 BHN.

8 DIMENSIONS

8.1 The nominal outside diameter and wall thickness of the tube alongwith permissible tolerances shall be as given in Table 3.

8.2 Length

The tubes shall be supplied cut to required lengths. The permissible variation on nominal length shall be $^{+\ 3\cdot0\ \text{mm.}}_{-\ 0\cdot0\ \text{mm}}$

8.2.1 Straightness

The tubes shall not deviate from straightness by more than 1·0 mm for every 1 000 mm length.

9 FINISH

9.1 The tubes after final heat treatment shall be chemically descaled or pickled free of scales. When bright annealing is used, pickling or chemical descaling is not necessary.

9.2 The finished tubes shall have smooth ends free from burrs.

9.3 The tubes may be supplied in dull or externally polished condition.

10 CORROSION RESISTANCE

When specifically required by the purchaser, the tubes shall be tested for corrosion resistance in accordance with the methods specified in IS 10461 (Parts 1 and 2) : 1983.

11 SAMPLING

11.1 Sampling for Chemical Analysis

11.1.1 If product analysis is required by the purchaser, at least one sample product shall be taken from each cast. The selection of samples shall be as agreed to between the purchaser and the manufacturer.

Table 3 Dimensions

(*Clause* 8.1)

Nominal Outside Diameter, mm	Nominal Length of Tube, m	Tolerance on Outside Diameter, mm	Nominal Wall Thickness, mm	Tolerances on Wall Thickness, Percent
Up to 52	Up to 5	+ 0·0 — 0·4	1·2	± 7%
Up to 52	5 — 10	+ 0·0 — 0·4	1·6	
52 – 76	Up to 5	+ 0·0 — 0·6	1·6	
76 — 102	Up to 5	+ 0·0 — 0·7	1·6	

11.2 Sampling for Mechanical Properties and Dimensions

11.2.1 For ensuring conformity to mechanical properties and dimensional requirements, sampling of tubes shall be done in accordance with the requirements prescribed in IS 4711 : 1974.

12 MARKING

12.1 Each tube shall be indelibly marked with chemically non-injurious ink or electrolytically etched with the following details:

a) Manufacturer's name or trade-mark,
b) Steel designation,
c) Heat number,
d) Length,
e) Nominal outside diameter, and
f) Nominal wall thickness.

12.2 Each tube may also be marked with the Standard Mark.

13 ORDERING INFORMATION

The purchaser shall provide the following information when making orders for tubes.

a) Quantity;
b) Designation of steel;
c) Nominal length of each tube;
d) Nominal outside diameter;
e) Nominal wall thickness; and
f) Any supplementary test requirement.

14 PACKING

The finished tubes shall be packed in strong wooden boxes lined with polyethylene sheets so as to remain intact during transportation and storage.

Standard Mark

The use of the Standard Mark is governed by the provisions of the *Bureau of Indian Standards Act*, *1986* and the Rules and Regulations made thereunder. The Standard Mark on products covered by an Indian Standard conveys the assurance that they have been produced to comply with the requirements of that standard under a well defined system of inspection, testing and quality control which is devised and supervised by BIS and operated by the producer. Standard marked products are also continuously checked by BIS for conformity to that standard as a further safeguard. Details of conditions under which a licence for the use of the Standard Mark may be granted to manufacturers or producers may be obtained from the Bureau of Indian Standards.

Bureau of Indian Standards

BIS is a statutory institution established under the *Bureau of Indian Standards Act, 1986* to promote harmonious development of the activities of standardization, marking and quality certification of goods and attending to connected matters in the country.

Copyright

BIS has the copyright of all its publications. No part of these publications may be reproduced in any form without the prior permission in writing of BIS. This does not preclude the free use, in the course of implementing the standard, of necessary details, such as symbols and sizes, type or grade designations. Enquiries relating to copyright be addressed to the Director (Publications), BIS.

Revision of Indian Standards

Indian Standards are reviewed periodically and revised, when necessary and amendments, if any, are issued from time to time. Users of Indian Standards should ascertain that they are in possession of the latest amendments or edition. Comments on this Indian Standard may be sent to BIS giving the following reference:

Doc : No. FAD 2 (4178)

Amendments Issued Since Publication

Amend No.	Date of Issue	Text Affected

BUREAU OF INDIAN STANDARDS

Headquarters :

Manak Bhavan, 9 Bahadur Shah Zafar Marg, New Delhi 110002
Telephones : 331 01 31, 331 13 75

Telegrams : Manaksanstha
(Common to all Offices)

Regional Offices :		Telephone
Central :	Manak Bhavan, 9 Bahadur Shah Zafar Marg NEW DELHI 110002	311 01 31 331 13 75
Eastern :	1/14 C. I. T. Scheme VII M, V. I. P. Road, Maniktola CALCUTTA 700054	37 86 62
Northern :	SCO 445-446, Sector 35-C, CHANDIGARH 160036	53 38 43
Southern :	C. I. T. Campus, IV Cross Road, MADRAS 600113	235 02 16
Western :	Manakalaya, E9 MIDC, Marol, Andheri (East) BOMBAY 400093	6 32 92 95

Branches : AHMADABAD, BANGALORE, BHOPAL, BHUBANESHWAR, COIMBATORE, FARIDABAD, GHAZIABAD, GUWAHATI, HYDERABAD, JAIPUR, KANPUR, PATNA, THIRUVANANTHAPURAM.

Printed at Printwell Printers, Aligarh, India